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Energy Supply Technical Work Group
Policy Option Descriptions
For the May 16, 2006 CCAG Meeting

Table 3.

Energy Supply Technical Work Group

Summary List of Draft Policy Options (12 Total)

#	Policy Name	GHG Savings (MMtCO_2e)	Cost Effectiveness (\$/tCO_2e)
	RENEWABLE AND LOW-EMITTING ENERGY		
ES-1	Environmental Portfolio Standard / Renewable Energy Standard and Tariff	1a(0) 2010: 0.80 2020: 4.4	\$13
		1a(1) 2010: 1.39 2020: 8.0	\$8
		1a(2) 2010: 1.42 2020: 7.7	\$12
		1b 2010: 2.31 2020: 9.2	\$4
		1c 2010: 4.19 2020: 16.4	\$6
ES-2	Public Benefit Charge Funds	2010: 1.46 2020: 4.1	\$280
ES-3	Direct Renewable Energy Support (including Tax Credits and Incentives, R&D, and siting/zoning)	**(via RCI-7)** 2010: 0.1 2020: 2.1	**(via RCI-7)** \$31
	EMISSIONS POLICIES		

ES-4	GHG Cap and Trade	(1) 2010: -0.28 2020: 4.4 (2) 2010: 0.17 2020: 2.0 (3) 2010: -0.2 2020: 16.5 (4) 2010: 0.18 2020: 18.5	$7 $10 $17 $19
ES-5	Generation Performance Standards	2010: 5.63 2020: 10.2	$29
ES-6	Carbon Intensity Targets	2010: 0.0 2020: 14.0	$44
ES-7	Voluntary Utility CO2 Targets and/or Trading	2010: 0.0 2020: 2.2	$29
ES-8	CO2 Tax	2010: 0.53 2020: 2.4	$3
	GRID AND UTILITY POLICIES		
ES-9	Reduce Barriers to Renewables and Clean DG	**(via RCI-6)** 2010: 0.4 2020: 2.7	**(via RCI-6)** -$25
ES-10	Metering Strategies		
ES-11	Pricing Strategies	**(via RCI-8)**	**(via RCI-8)**
ES-12	Integrated Resource Planning	2010: 0.06 2020: 5.4	–$2

Table 4.

Description of Draft Energy Supply Policy Options

RENEWABLE AND LOW-EMITTING ENERGY

ES-1 Environmental Portfolio Standard / Renewable Energy Standard and Tariff (REST)

Policy Description:

An environmental portfolio standard (EPS) is a requirement that utilities must supply a certain percentage of electricity from environmentally friendly sources. An EPS differs from a Renewable Portfolio Standard (RPS) in that an EPS can include more options than renewables for meeting the requirement. Utilities can meet their requirements by purchasing or generating environmentally friendly electricity or by purchasing clean energy credits. By giving utilities the flexibility to purchase clean energy credits, a market in these credits will emerge that will provide an incentive to companies that are best able to generate clean energy, either through energy efficiency or renewables. Other options for meeting the requirement are possible depending on how the EPS is structured. For example, a provision can be included so that funding for research and development is applied toward meeting a utility's commitment.

Policy Design:

ES-1a(0): The likely changes by the Arizona Corporations Commission (ACC) to the EPS applied only to ACC-jurisdictional utilities: 5% in 2015, 15% in 2025; Starting in 2007, 5% of the total renewable requirement must be from distributed renewables, increasing to 30% by 2011 and remaining at 30% in future years. Renewable Energy Credit (REC) trading is allowed, provided that all other associated attributes are retired when applying RECs to the Annual Renewable Energy Requirement; out-of-state resources can be used provided that the necessary transmission rights are obtained and utilized.

ES-1a(1): **The ACC's likely changes to the EPS, with SRP continuing with its proposed renewable investments**. The SRP has set a target to generate 15% of its electricity from renewable resources by 2025.

ES-1a(2): The ACC's likely changes to the EPS extended statewide.

ES-1b: Alternative scenario for ACC jurisdictional utilities: 1% in 2005, increasing 1% each year to 26% in 2025. Allow out-of-state renewables and REC trading.

ES-1c: Alternative scenario extended statewide.

- **Goal levels:** As noted above.
- **Timing:** As noted above.
- **Parties:** Utilities as noted above.

- **Other:** Apply a least-cost approach, reflecting resource availability constraints, to determine which renewable energy resources and technologies would be used to meet the EPS beyond the specific requirements laid out in the proposals.

Implementation method(s): An EPS is usually implemented through a regulatory requirement (mandate) on the applicable utilities.

Related Policies/Programs in place:

In the existing EPS, utilities (not including SRP) must generate a specified percentage of their total retail sales from renewable energy:

- Started in 2001 at 0.2% and increased annually to 1% in 2005 and will increase to 1.1% in 2007. Expires in 2012.
- 2001–2003: 50% of current EPS requirement must be solar electric; remainder can be other environmentally friendly technologies including no more than 10% R&D.
- 2004–2012: 60% of resources must be solar electric.
- Environmental Portfolio Surcharge of $0.000875 per kWh with caps by customer class.

Type(s) of GHG Benefit(s):

- CO2: By creating a substantial market in renewable generation, an EPS can reduce fossil fuel use in power generation, and correspondingly reducing CO2 emissions
- Black Carbon: To the extent that generation from coal and oil is displaced by renewables, black carbon emissions will decrease.

Estimated GHG Savings and Costs Per Ton:

#	Policy	Scenario	Reductions (MMTCO2e)			NPV (2006–2020) $ millions	Cost-Effective-ness $/tCO2
			2010	2020	Cumulative Reductions (2006 - 2020)		
ES-1	RE/Std/Tariff, ES-1a(0)	ACC Proposal alone	0.80	4.4	26	331	13
ES-1	RE/Std/Tariff, ES-1a(1)	ACC Proposal + SRP program	1.39	8.0	47	366	8
ES-1	RE/Std/Tariff, ES-1a(2)	ACC Proposal Statewide	1.42	7.7	46	538	12
ES-1	RE/Std/Tariff, ES-1b	Alternative Proposal for ACC Utilities	2.31	9.2	65	281	4
ES-1	RE/Std/Tariff, ES-1c	Alternative Proposal	4.19	16.4	116	752	6

		Statewide					

Data Sources, Methods and Assumptions (for quantified actions):

- **Data Sources:** CDEAC, WECC, EIA, EPA, Arizona Solar Energy Center, "*Assessment of Parabolic Trough and Power Tower Solar Technology Cost and Performance Forecasts*" by Sargent & Lundy.
- **Quantification Methods:** A simple capacity expansion model was developed in Excel specifically for this policy option. A trajectory of MWhs needed to satisfy the REST requirement was calculated, both for central renewable generation and distributed renewables. Renewable and fossil technologies were characterized in terms of cost and operating profiles, and available resources in the state were also defined. Technologies include three classes of wind, concentrating solar power, geothermal, biomass, landfill gas, distributed solar PV, distributed solar thermal, conventional coal, integrated gasification combined cycle with carbon capture and storage (IGCC with CCS), natural gas combined cycle (NGCC), and natural gas combustion turbines (NGCT). We assumed that 75% of the Renewable Energy Standard and Tariff (REST) requirement would be met through REC trading. We also assumed that corresponding CO2 reductions would be bundled with the RECs and count toward the emission reduction performance of this policy. We assumed a $5 per MWh REC price, which is consistent with available low-cost wind and other renewable resources in the West and is consistent with REC price assumptions in Integrated Resource Plans by various western utilities as reported in *Balancing Cost and Risk: The Treatment of Renewable Energy in Western Utility Resource Plans* (August 2005, Lawrence Berkeley National Laboratory). The model found the least-cost mix of renewables, constrained by available resources, to satisfy 25% of the central renewable requirement. An assumption that the distributed renewable requirement will be met by 50% solar PV and 50% solar thermal was made. Each renewable was also defined by the share of generation it displaces from NGCT, NGCC, and coal. The model then determines how many MWhs of NGCT, NGCC and coal would be displaced and the corresponding CO2 emissions. The model also tracks the cost of generation for renewables and the displaced fossil; the present value of the difference is reported above.
- **Key Assumptions:** Cost and performance characteristics of generating technologies; resource availability; no demand response as a result of policy; no transmission and distribution modeled.

Key Uncertainties:

As with any assessment of the future, this analysis has many uncertainties. Key uncertainties are, first, related directly to the key assumptions listed above. If those assumptions are incorrect, then the results would change. Other uncertainties include the forecast of the price of fossil fuels and the growth in the demand for electricity.

Ancillary Benefits and Costs, if applicable:

- Reductions in overall energy consumption and the shift from fossil fuel generation as a result of an EPS will lead to reductions in criteria air pollutants and, consequently, lower health impacts and costs associated with those pollutants.
- Water use may be reduced through renewable versus combustion technologies.
- While much of the EPS requirement will come from low-cost renewables such as wind and biomass, meeting the requirement may lead to a moderate increase in direct costs to utilities implementing the EPS policy and a small increase in overall electricity system cost for Arizona. At the same time, investment in new technologies resulting from the EPS may spur economic development and corresponding job growth, and to the extent the renewable energy is derived from Arizona-based capital projects, additional local tax revenues will also be generated.

Feasibility Issues, if applicable:

Status of Group Approval: (Pending or Completed)

Level of Group Support: (Unanimous Consent, Supermajority, Majority, or Minority)

Barriers to consensus (if less than unanimous consent):

ES-2 Public Benefit Charge Funds

Policy Description:

A public benefit fund (PBF) is a state fund dedicated to support energy efficiency (EE) and renewable energy (RE), funded through a per kiloWatthour charge on electricity sales. To date, nineteen states have implemented PBF programs. A small charge rate, typically in the 2 to 5 mils per kWh range, is applied to electricity sales in the state and collected by a PBF manager. Funds are typically used to support EE and RE in a number of ways, such as through public education, R&D, demonstration projects, direct grants/buy-downs/tax credits to subsidize advanced technologies, and low interest revolving loans. Funding goes to the residential, commercial and industrial sectors. Fund managers decide which technologies to support based on criteria such as GHG reduction potential, cost-effectiveness, co-benefits, etc.

Policy Design:

Introduce a 4 mils ($0.004) per kWh charge to be applied as determined by an authorized entity, probably the ACC. For the purposes of analysis, we assume that 1 mil per kWh is available for distributed renewable generation; the remaining portion of the fund is applied to energy efficiency projects and is quantified by the RCI TWG. We assume that 50% of renewable funding supports solar photovoltaics and 50% supports solar thermal technologies. The total sum raised would be approximately $100-145 million per year for distributed renewables.

- **Goal levels:** As noted above.
- **Timing:** ASAP.
- **Parties:** Public Benefit Fund Manager created by legislature. Utilities will collect the charges from customers and transfer to the Fund Manager. Fund Manager will distribute money to be implemented at the residential, commercial and industrial levels.

- Other:

Implementation method(s):

- Funding mechanisms and or incentives
- Pilots and demos
- Research and development
- Education

Related Policies/Programs in place: There is no PBF in place in Arizona.

Type(s) of GHG Benefit(s):

- CO2: By spurring investment in energy efficient technologies and small-scale renewable generators, PBF programs reduce the need for generation from fossil fuel plants, which can lead to a significant reduction in GHG emissions.
- Black Carbon: To the extent that generation from coal and oil is displaced by energy efficiency and renewables, black carbon emissions will decrease.

Estimated GHG Savings and Costs Per Ton:

#	Policy	Scenario	Reductions (MMTCO2e)			NPV (2006–2020) $ millions	Cost-Effective-ness $/tCO2
			2010	2020	Cumulative Reductions (2006 - 2020)		
ES-2	Public Benefits Fund	(Distributed Renewables only)	1.46	4.1	34	9383	280

Data Sources, Methods and Assumptions (for quantified actions):

- **Data Sources:** CDEAC, WECC, EIA, EPA, Arizona Solar Energy Center, "*Assessment of Parabolic Trough and Power Tower Solar Technology Cost and Performance Forecasts*" by Sargent & Lundy.
- **Quantification Methods:** A simple capacity expansion model was developed in Excel specifically for this policy option. This policy was partly analyzed by the RCI TWG. We assumed that 1 mil per kwh of the 4 mils charge in this policy would be devoted to distributed renewable generation. The 1 mil per kwh charge was applied to the reference case forecast of electricity generation to determine the total annual funding available. We assumed that half of the funding would go toward PV and half toward solar thermal. The funding would cover the difference between the cost of distributed renewables and the retail cost of electricity, reflecting the incremental funding needed to achieve the investment. Renewable and fossil technologies were characterized in terms of cost and

operating profiles, and available resources in the state were also defined. The model calculated the PV and solar thermal generation resulting from the PBF funding. Each distributed renewable was also defined by the share of generation it displaces from NGCT, NGCC, and coal. The model then determines how many MWhs of NGCT, NGCC and coal would be displaced and the corresponding CO2 emission reductions. The model also tracks the cost of generation for renewables and the displaced fossil; the present value of the difference is reported above.

- **Key Assumptions:** Cost and performance characteristics of generating technologies now and in the future; resource availability; no demand response as a result of policy; no transmission and distribution modeled.

Key Uncertainties:

- As with any assessment of the future, this analysis has many uncertainties. Key uncertainties are, first, related directly to the key assumptions listed above. If those assumptions are incorrect, then the results would change. Other uncertainties include the forecast of the price of fossil fuels and the growth in the demand for electricity.

Ancillary Benefits and Costs, if applicable:

- Reductions in overall energy consumption and the shift from fossil fuel generation as a result of a PBF will lead to reductions in criteria air pollutants and, consequently, health impacts and costs associated with those pollutants.
- Water use may be reduced through renewable versus combustion technologies.
- Much of the investment made by the PBF will go into zero- or low-cost (even negative-cost) energy efficiency and small-scale renewables, and the PBF program can more than pay for itself through cost-effective investments. Nevertheless, the impact on the larger electricity system of the PBF program can lead to a small increase in overall electricity system cost. At the same time, though, investment in new technologies resulting from the PBF could spur economic development in Arizona.

Feasibility Issues, if applicable:

Status of Group Approval: (Pending or Completed)

Level of Group Support: (Unanimous Consent, Supermajority, Majority, or Minority)

Barriers to consensus (if less than unanimous consent):

ES-3 Direct Renewable Energy Support (including Tax Credits and Incentives, R&D, and siting/zoning)

Policy Description:

The purpose of this suite of policies is to encourage investment in renewables by providing direct financial incentives and by removing siting and zoning barriers to renewable energy facilities. Development of new renewable technologies is also encouraged by funding R&D.

Direct renewable energy support can take many forms including: (1) direct subsidies for purchasing/selling renewable technologies given to the buyer/seller; (2) tax credits or exemptions for purchasing/selling renewable technologies given to the buyer/seller; (3) tax credits or exemptions for operating renewable energy facilities; (4) feed-in tariff, which is a direct payment to renewable generators for each kWh of electricity generated from a qualifying renewable facility; and (5) tax credits for each kWh generated from a qualifying renewable facility.

R&D funding can be targeted toward a particular technology or group of technologies as part of a state program to build an industry around that technology and/or to set the stage for adoption of the technology in the state. R&D funding can also be made available to any renewable or other advanced technology through an open bidding procedure (i.e., driven by bids received rather than by an effort to develop a particular technology). Funding can also be provided for demonstration projects to help commercialize technologies that have already been developed but are not yet in widespread use.

Many renewable energy technologies – particularly wind power – face siting and zoning obstacles. Often the best wind resources are in scenic areas, which can spur opposition to development. Further, they may not be near existing transmission lines. Policies can be developed to help overcome these barriers.

Policy Design:

See RCI-7, Distributed Generation/Renewable Energy Applications.

- **Goal levels:** As noted above.
- **Timing:** As noted above.
- **Parties:** A state agency would administer the direct subsidies, and individuals, commercial enterprises, industrial enterprises would receive them. Utilities would administer the feed-in tariff under supervision of a state agency, and independent power producers operating qualifying renewable facilities would receive the payments. A state agency would administer R&D funding through a public-private partnership with companies and research institutions. Note that a source of funds to cover subsidies or other support would have to be determined.

Implementation method(s):

- Funding mechanisms and or incentives
- Pilots and demos
- Research and development

Related Policies/Programs in place:

- Personal income tax credit for renewables amounting to 25% of the cost of installation with a maximum of $1,000.
- Sales tax exemption for up to $5,000 of the cost of a renewable installation.

Type(s) of GHG Benefit(s): (indicate which GHGs to be reduced)

- CO2: By providing a financial incentive for renewable generation and helping overcome siting and zoning barriers facing renewables, more renewable facilities will be installed and more electricity from renewables will be generated. This zero carbon generation will displace generation from fossil fuels and lower carbon emissions. By funding R&D, new or improved renewable technologies will be developed or commercialized, leading to even more installation of renewables and resulting reduction in carbon emissions in the long term.

- Black Carbon: To the extent that generation from coal and oil is displaced by renewables, black carbon emissions will decrease.

Estimated GHG Savings and Costs Per Ton:

- This option is being quantified by RCI under RCI-7, Distributed Generation/Renewable Energy Applications

Data Sources, Methods and Assumptions (for quantified actions):

- **See RCI-7, Distributed Generation/Renewable Energy Applications**

Key Uncertainties:

- **See RCI-7, Distributed Generation/Renewable Energy Applications**

Ancillary Benefits and Costs, if applicable:

- Reductions in overall electricity consumption and the shift from fossil fuel generation as a result of new renewables will lead to reductions in criteria air pollutants and, consequently, health costs associated with those pollutants.
- Water use may be reduced through renewable versus combustion technologies.
- Renewable resources may be less risky than fossil resources because they are not subject to unexpected changes in the price of fossil fuels.
- The operating costs of renewable generation, primarily maintenance, are spent locally and are a direct boost to local and state economies, whereas the primary cost of operating fossil fuel plants – fossil fuels – may go out of state and not contribute to the local or state economy.

Feasibility Issues, if applicable:

Status of Group Approval: (Pending or Completed)

Level of Group Support: (Unanimous Consent, Supermajority, Majority, or Minority)

Barriers to consensus (if less than unanimous consent):

EMISSIONS POLICIES

ES-4 GHG Cap and Trade Program

Policy Description:

A cap and trade system is a market mechanism in which CO2 emissions are limited or capped at a specified level, and those participating in the system can trade permits (a permit is an allowance to emit one ton of CO2) in order to lower costs of compliance. For every ton of CO2 released, an emitter must hold a permit. Therefore, the number of permits issued or allocated is, in effect, the cap. The government can give permits away for free (according to any one of many different criteria to those participating in the cap & trade system or even to those who are not), auction them, or a combination of the two. Participants can range from a small group within a single sector to the entire economy and can be implemented upstream (at the level of fuel extraction or import) or downstream at the points where fuel is consumed.

Policy Design:

The TWG's primary interests are in a national or regional economy-wide cap and trade program. The TWG will look at existing studies of such programs to infer what the impact on Arizona may be. The TWG will also conduct comparative analyses concerning the costs of reaching a given cap on a national and a regional basis. It may be possible to explore these two options for both an economy-wide and a power-sector-only program.

There was some interest in exploring a cap-only program for the state, but it appears that such an approach would effectively echo other policy options being considered, such as an EPS or a GPS. The CCAG agreed that the ES TWG would further discuss evaluation of a single state cap only approach to determine if support for the measure could be broadened through alternate configurations.

Other issues to consider:

- Applicability (sources & sectors included)
- Gases included
- Permit allocation rules (method; options for new market entrants)
- Generation-based or load-based; leakage concerns
- Linkage to other trading systems
- Banking and borrowing; early reduction credit
- Inclusion of emission offsets (within or outside sector, geography)
- Incentive opportunities (e.g., interaction with other pollution regulations like Pennsylvania's EDGE program).

For illustration of the potential impact of various levels of a national cap and trade program, we analyzed four national cap and trade scenarios published in March 2006 by the US Energy Information Administration. These scenarios are defined below under Goal Levels. The GHG reductions and cost results presented below are regional results that have been scaled to approximate what would occur in Arizona.

- **Goal levels:**

Case Name	GHG Intensity Reduction Goal (percent per year)		Safety-valve Price (2004 dollars per metric ton CO_2 equivalent)		Other
	2010-2019	2020-2030	2010	2030	
Cap-Trade 1	2.4	2.8	$ 6.16	$ 9.86	Greenhouse gas cap-and-trade system with safety-valve.
Cap-Trade 2	2.6	3.0	$ 8.83	$14.13	
Cap-Trade 3	2.8	3.5	$22.09	$35.34	
Cap-Trade 4	3.0	4.0	$30.92	$49.47	

- **Timing:** As noted above.
- **Parties:**

Implementation method(s):

- Market-based mechanisms with underlying regulatory obligation.

Related Policies/Programs in place:

- No cap & trade system is in place in Arizona.

Type(s) of GHG Benefit(s):

- CO2: A cap & trade system is a direct limit on CO2 emissions. Reductions are determined by the level of the cap.
- Black Carbon: To the extent that generation from coal and oil declines under a cap and trade system, black carbon emissions will also decrease.

Estimated GHG Savings and Costs Per Ton:

#	Policy	Scenario	Reductions (MMTCO2e)			NPV (2006–2020) $ millions	Cost-Effective-ness $/tCO2
			2010	2020	Cumulative Reductions (2006 - 2020)		
ES-4	Cap & Trade 1	2.4% - 2.8% CI, $6.16 - $9.86 safety valve	-0.28	4.4	7	51	7
ES-4	Cap & Trade 2	2.6% - 3.0% CI, $8.83 - $14.13 safety valve	0.17	2.0	9	85	10
ES-4	Cap & Trade 3	2.8% - 3.5% CI, $22.09 - $35.34 safety valve	-0.20	16.5	63	1096	17

ES-4	Cap & Trade 4	3.0% - 4.0% CI, $30.92 - $49.47 safety valve	0.18	18.5	88	1630	19

Data Sources, Methods and Assumptions (for quantified actions):

- **Data Sources:** Data for the electricity modeling done in this analysis comes from the US Energy Information Administration (EIA) and can be found within the National Energy Modeling System (NEMS). Data in NEMS includes representation of the existing generation, transmission and distribution system down to the unit level. NEMS also includes data that characterizes new plants that the model can choose to build to meet projected demand growth. EIA publishes Assumptions to the Annual Energy Outlook that details key assumptions in the current version of the model. EIA also publishes NEMS model documentation.
- **Quantification Methods:** The modeling presented here was done by the Energy Information Administration in a Congressional Service Report from March 2006 entitled "*Energy Market Impacts of Alternative Greenhouse Gas Intensity Reduction Goals*." The scenarios are listed above and are for national cap and trade policies. We scaled the impacts to approximate results in Arizona for the four scenarios presented here in the same way that we analyzed the NEMS modeling done specifically for this process. For the cap and trade scenarios, we approximated the cost of the policies by multiplying CO2 reductions by one-half of the market price for CO2 allowances. (The allowance price is the marginal price of allowances needed to produce the reported emission reductions; the actual cost of each ton of reductions ranges from zero up to the price of allowances. For simplicity, we assume that the actual cost is an average of the high (market clearing price) and low (zero) cost of reductions, which equals one-half of the market clearing price). We report costs as a net present value of the stream of costs from 2006 – 2020. We found the number of tons reduced by taking the difference between the emissions in the policy case and a reference case NEMS run. Because the NEMS model is a national model with multi-state regions (Arizona is within the Rocky Mountain Power Area), the results for Arizona were derived from results in the region. We shared out the regional emission and cost results according to the share of Arizona generation within the region.
- **Key Assumptions:** Any analysis of state-level policies using the National Energy Modeling System (NEMS) from the US Energy Information Administration should be weighed carefully. NEMS is a national model that consists of 13 regions. State policies cannot be implemented explicitly within NEMS, and the state-specific impacts cannot be known explicitly. We must make assumptions about the impact of policies at the state level by sharing out regional results. In reality, the state-level changes resulting from policy may differ substantially from the changes in the region.

Key Uncertainties: As with any assessment of the future, this analysis has many uncertainties. Key uncertainties are related directly to the key assumptions and quantification methods listed above. If those assumptions are incorrect, then the results would change. Other uncertainties include the forecast of the price of fossil fuels and the growth in the demand for electricity.

Ancillary Benefits and Costs, if applicable:

- The shift from fossil fuel generation as a result of a cap and trade system will lead to reductions in criteria air pollutants and, consequently, health impacts and costs associated with those pollutants.
- Water use may be reduced through renewable versus combustion technologies.
- Allowing "offsets" from outside the capped sector can create the incentive to quantify and reduce GHG emissions from sources in other sectors.
- The shift in fossil fuel resources as a result of a cap and trade system could have unintended consequences, including increased cost of natural gas and need for additional natural gas infrastructure.

Feasibility Issues, if applicable:

Status of Group Approval:

Level of Group Support:

Barriers to consensus (if less than unanimous consent):

ES-5 Generation Performance Standards

Policy Description:

A generation performance standard (GPS) is typically a requirement that electricity utilities or load serving entities (LSE) sell electricity with an average emission rate below a specified mandatory standard. Utilities must take action to ensure that their generation mix meets the standard.

A variation of a GPS is to incorporate the standard within a cap and trade system in which permits are allocated by dividing the total cap by the total number of MWhs generated to arrive at the performance standard. Permits are then given to each participant based on its own generation multiplied by the performance standard. Generators with emission rates lower than the GPS would receive more allowances than they need. Generators with emission rates higher than the GPS would receive fewer allowances than needed. As electricity generation increases, everything else being equal, the number of permits per MWh would decline because of the cap.

A third variation of a GPS is to establish the standard and allocate allowances based on that standard every year. In this variation, as electricity generation increases, plants would receive more permits. Utilities could trade permits in order to achieve the standard, but there would be no fixed cap on emissions. This variation provides a financial incentive (via trading) for generators to reduce emissions so that they can sell unneeded permits to generators who have high emissions.

Policy Design:

Apply a GPS only to new generation. As new capacity comes on-line, those plants would receive an allocation based on the GPS standard. Utilities could trade permits in order to achieve the standard, but there would be no fixed cap on emissions. The GPS level would be equivalent to a new natural gas combined cycle plant. Assessment of this option should consider that new electricity demand in Arizona might be served, at least in part, by out-of-state resources.

Accordingly, analysis of this option should consider how a GPS policy might affect decisions to build new capacity inside or outside of Arizona.

- **Goal levels:** Set a GPS equivalent to a new natural gas combined cycle plant.
- **Timing:** As new generation capacity is built.
- **Parties:** Utilities (electricity generators).
- Other:

Implementation method(s):

- Market based mechanisms with underlying regulatory obligation.

Related Policies/Programs in place:

- No GPS system is in place in Arizona.

Type(s) of GHG Benefit(s):

- CO_2: A cap & trade system is a direct limit on CO_2 emissions. Reductions are determined by the level of the cap.
- Black Carbon: To the extent that generation from coal and oil declines under a cap and trade system, black carbon emissions will also decrease.

Estimated GHG Savings and Costs Per Ton:

#	Policy	Scenario	Reductions (MMTCO2e)			NPV (2006–2020) $ millions	Cost-Effective-ness $/tCO2
			2010	2020	Cumulative Reductions (2006 - 2020)		
ES-5	Generation Performance Standard	All new supply (generated or imported) as clean as NGCC	5.63	10.2	104	2980	29

Data Sources, Methods and Assumptions (for quantified actions):

- **Data Sources:** CDEAC, WECC, EIA, EPA, Arizona Solar Energy Center, "*Assessment of Parabolic Trough and Power Tower Solar Technology Cost and Performance Forecasts*" by Sargent & Lundy.
- **Quantification Methods:** A simple capacity expansion model was developed in Excel specifically for this policy option. Renewable and fossil technologies were characterized in terms of cost and operating profiles, and available resources in the state were also defined. Technologies include three classes of wind, concentrating solar power,

geothermal, biomass, landfill gas, conventional coal, integrated gasification combined cycle with carbon capture and storage (IGCC with CCS), natural gas combined cycle (NGCC), and natural gas combustion turbines (NGCT). The reference case forecast of electricity generation was the starting point for this analysis. We assumed that existing resources would continue to operate in the state over the analysis period. We subtracted generation from existing resources from the reference forecast of total generation to find a new generation forecast. The model then found the least-cost mix of new generation needed, subject to the constraint that all new generation must have an equal or lower emission rate than new natural gas combined cycle plants. The model tracks cost and CO2 emissions associated with new generation. We also ran the model without constraints to develop a reference case. We then calculate the difference in CO2 emissions and total cost of generation between the policy case and the reference case. Those results are reported above.

- **Key Assumptions:** Cost and performance characteristics of generating technologies now and in the future; resource availability; no demand response as a result of policy; no transmission and distribution modeled.

Key Uncertainties: As with any assessment of the future, this analysis has many uncertainties. Key uncertainties are, first, related directly to the key assumptions listed above. If those assumptions are incorrect, then the results would change. Other uncertainties include the forecast of the price of fossil fuels and the growth in the demand for electricity.

Ancillary Benefits and Costs, if applicable:

- The shift from fossil fuel generation as a result of a GPS system will lead to reductions in criteria air pollutants and, consequently, health impacts and costs associated with those pollutants.

Feasibility Issues, if applicable:

Status of Group Approval:

Level of Group Support:

Barriers to consensus (if less than unanimous consent):

ES-6 Carbon Intensity Targets

Policy Description:

Rather than a fixed cap on carbon emissions, a carbon intensity target is a limit on the ratio of carbon emissions to a measure of output. Absolute emissions can increase as output increases. Measures of output are clear for some sectors like electricity generation (e.g., MWh), but can difficult for other sectors (e.g., manufacturing). One measure of output for other sectors could be dollars equal to the value of the output.

Policy Design:

Arizona implements a mandatory carbon intensity target that begins in 2010 (equal to carbon intensity in 2010) and that declines by 3% annually through 2025. The carbon intensity target is translated annually into a cap, and trading is allowed under that cap.

- **Goal levels:** As noted above.
- **Timing:** As noted above.
- **Parties:** Utilities and electric generators.
- **Other:**

Implementation method(s):

- Market based mechanisms with underlying regulatory obligation.

Related Policies/Programs in place:

- No carbon intensity target is in place in Arizona.

Type(s) of GHG Benefit(s):

- CO2: A carbon intensity target may or may not reduce CO2 emissions. A stringent intensity target is more likely to lead to reductions than a lenient target. A less stringent target may curb growth in emissions, but not reduce absolute emissions.
- Black Carbon: To the extent that generation from coal and oil declines under a carbon intensity target, black carbon emissions will also decrease.

Estimated GHG Savings and Costs Per Ton:

#	Policy	Scenario	Reductions (MMTCO2e)			NPV (2006–2020) $ millions	Cost-Effective-ness $/tCO2
			2010	2020	Cumulative Reductions (2006 - 2020)		
ES-6	Carbon Intensity Target	Intensity improvement of 3%/year 2010-2025	0.00	14.0	70	3119	44

Data Sources, Methods and Assumptions (for quantified actions):

- **Data Sources:** CDEAC, WECC, EIA, EPA, Arizona Solar Energy Center, "*Assessment of Parabolic Trough and Power Tower Solar Technology Cost and Performance Forecasts*" by Sargent & Lundy.
- **Quantification Methods:** A simple capacity expansion model was developed in Excel specifically for this policy option. Renewable and fossil technologies were characterized in terms of cost and operating profiles, and available resources in the state were also defined. Technologies include three classes of wind, concentrating solar power, geothermal, biomass, landfill gas, conventional coal, integrated gasification combined

cycle with carbon capture and storage (IGCC with CCS), natural gas combined cycle (NGCC), and natural gas combustion turbines (NGCT). The reference case forecast of electricity generation was the starting point for this analysis. We assumed that existing resources would continue to operate in the state over the analysis period. We subtracted generation from existing resources from the reference forecast of total generation to find a new generation forecast. The model then found the least-cost mix of new generation needed, subject to the constraint that CO2 emissions not exceed the limit imposed by the carbon intensity target. The model tracks cost and CO2 emissions associated with new generation. We also ran the model without constraints to develop a reference case. We then calculate the difference in CO2 emissions and total cost of generation between the policy case and the reference case. Those results are reported above.

- **Key Assumptions:** Cost and performance characteristics of generating technologies now and in the future; resource availability; no demand response as a result of policy; no transmission and distribution modeled.

Key Uncertainties:

- As with any assessment of the future, this analysis has many uncertainties. Key uncertainties are, first, related directly to the key assumptions listed above. If those assumptions are incorrect, then the results would change. Other uncertainties include the forecast of the price of fossil fuels and the growth in the demand for electricity.

Ancillary Benefits and Costs, if applicable:

- The shift from fossil fuel generation as a result of a carbon intensity target will lead to reductions in criteria air pollutants and, consequently, health impacts and costs associated with those pollutants.

Feasibility Issues, if applicable:

Status of Group Approval:

Level of Group Support:

Barriers to consensus (if less than unanimous consent):

ES-7 Voluntary Utility CO2 Targets and/or Trading

Policy Description:

Voluntary targets can take a number of different forms. A target can be voluntarily undertaken by a company outside the context of a government program for voluntary reduction and not be legally binding.

US companies are free to take on such voluntary CO2 reduction targets, and a number of them have done so. The Chicago Climate Exchange (CCX) is an example of a trading exchange driven by voluntary participants making and selling reductions. A target could also be negotiated with the government through a program for voluntary reductions. The government might offer certain incentives, and companies voluntarily agree to reduction targets in exchange for receiving those incentives. Such agreements can be legally binding or not. Trading can be a component of any of these voluntary target variations. The most active trading, however, is likely to result with a negotiated but binding agreement.

Monitoring, reporting and verification systems need to be in place to ensure that reductions are actually being made, as this kind of system would not involve allocated permits. If a company reduced GHG emissions beyond its target, and these reductions are verified independently, then it could sell those excess reductions to other participating companies that had difficulty meeting the target. If targets are not binding, however, companies may or may not actually achieve their reduction targets.

Policy Design:

The DOE Power Partners Initiative offers a possible model for a voluntary carbon intensity target in the power sector. This initiative calls for reductions in carbon intensity of 3-5% below 2000-2002 levels, as measured over the 2010-2012 period. The analysis was conducted assuming that a 3% reduction in intensity relative to 2000-2002 levels would be achieved in 2011. This decrement in carbon intensity was applied to all years beyond 2011.

- **Goal levels:** As noted above.
- **Timing:** As noted above.
- **Parties:** Utilities and electricity generators.
- Other:

Implementation method(s):

- Voluntary and or negotiated agreements
- Market-based mechanisms

Related Policies/Programs in place:

- Companies are free to take on voluntary non-binding reduction targets. No companies have done so. There are no programs in place to secure any voluntary but binding negotiated agreements to reduce GHG emissions.

Type(s) of GHG Benefit(s):

- CO2: Non-binding voluntary reductions may or may not result in an actual reduction in CO2 emissions. Binding reductions would result in a limit on CO2 emissions. Reductions would be determined either by the company or through a negotiation between the company and the state.
- Black Carbon: To the extent that generation from coal and oil declines under voluntary reduction targets, black carbon emissions will also decrease.

Estimated GHG Savings and Costs Per Ton:

			Reductions (MMTCO2e)		

#	Policy	Scenario	2010	2020	Cumulative Reductions (2006 - 2020)	NPV (2006–2020) $ millions	Cost-Effective-ness $/tCO2
ES-7	Voluntary Targets	3% intensity improvement in 2011	0.00	2.2	20	570	29

Data Sources, Methods and Assumptions (for quantified actions):

- **Data Sources:** CDEAC, WECC, EIA, EPA, Arizona Solar Energy Center, "*Assessment of Parabolic Trough and Power Tower Solar Technology Cost and Performance Forecasts*" by Sargent & Lundy.
- **Quantification Methods:** A simple capacity expansion model was developed in Excel specifically for this policy option. Renewable and fossil technologies were characterized in terms of cost and operating profiles, and available resources in the state were also defined. Technologies include three classes of wind, concentrating solar power, geothermal, biomass, landfill gas, conventional coal, integrated gasification combined cycle with carbon capture and storage (IGCC with CCS), natural gas combined cycle (NGCC), and natural gas combustion turbines (NGCT). The reference case forecast of electricity generation was the starting point for this analysis. We assumed that existing resources would continue to operate in the state over the analysis period. We subtracted generation from existing resources from the reference forecast of total generation to find a new generation forecast. The model then found the least-cost mix of new generation needed, subject to the constraint that CO2 emissions not exceed the limit imposed by the voluntary intensity target (assuming that intensity target would be achieved). The model tracks cost and CO2 emissions associated with new generation. We also ran the model without constraints to develop a reference case. We then calculate the difference in CO2 emissions and total cost of generation between the policy case and the reference case. Those results are reported above.
- **Key Assumptions:** Cost and performance characteristics of generating technologies now and in the future; resource availability; no demand response as a result of policy; no transmission and distribution modeled.

Key Uncertainties:

As with any assessment of the future, this analysis has many uncertainties. Key uncertainties are, first, related directly to the key assumptions listed above. If those assumptions are incorrect, then the results would change. Other uncertainties include the forecast of the price of fossil fuels and the growth in the demand for electricity.

Ancillary Benefits and Costs, if applicable:

- The shift from fossil fuel generation that may result from voluntary targets would lead to reductions in criteria air pollutants and, consequently, health impacts and costs associated with those pollutants.

Feasibility Issues, if applicable:

Status of Group Approval:

Level of Group Support:

Barriers to consensus (if less than unanimous consent):

ES-8 CO2 Tax

Policy Description:

A CO2 tax is a tax on every ton of CO2 emitted. Companies would either pass the cost on to consumers, change production to lower emissions, or a combination of the two. Either way, consumers would see the implicit cost of CO2 emissions in products and services and would adjust behavior to purchase substitute goods and services that result in lower CO2 emissions. Typically, a CO2 tax is put in place with an income tax reduction to offset the economic impact of the new tax. CO2 tax revenue could go completely to income tax reductions or part of it could go toward policies and programs to assist with CO2 reductions.

Policy Design:

Adopt a flat $5 per ton economy-wide, upstream CO2 tax, analyzing this tax as if adopted on a national basis and evaluating the resulting impact on Arizona. Other levels may be assessed to the extent that resources permit. Some members of the CCAG expressed concern about moving forward with analyzing this option.

- **Goal levels:** As noted above.
- **Timing:**
- **Parties:** All (economy-wide).
- Other:

Implementation method(s):

- Market-based (economic) mechanism with underlying legal obligation.

Related Policies/Programs in place:

- No CO2 tax is in place in Arizona.

Type(s) of GHG Benefit(s):

- CO2: A CO2 tax is a disincentive to emit CO2 emissions. Producers and consumers will adjust behavior to avoid the tax and thereby reduce CO2 emissions in the process.
- Black Carbon: To the extent that generation from coal and oil declines under a CO2 tax, black carbon emissions will also decrease.

Estimated GHG Savings and Costs Per Ton:

#	Policy	Scenario	Reductions (MMTCO2e)			NPV (2006–2020) $ millions	Cost-Effective-ness $/tCO2
			2010	2020	Cumulative Reductions (2006 - 2020)		
ES-8	CO2 Tax	$5/ton upstream tax, results are for electricity only	0.53	2.4	11	30	3

Data Sources, Methods and Assumptions (for quantified actions):

- **Data Sources:** Data for the electricity modeling done in this analysis comes from the US Energy Information Administration (EIA) and can be found within the National Energy Modeling System (NEMS). Data in NEMS includes representation of the existing generation, transmission and distribution system down to the unit level. NEMS also includes data that characterizes new plants that the model can choose to build to meet projected demand growth. EIA publishes Assumptions to the Annual Energy Outlook that details key assumptions in the current version of the model. EIA also publishes NEMS model documentation.
- **Quantification Methods:** We applied a tax of $5 per ton CO2 to electricity generators at the national level. CO2 reductions were found by comparing emissions from the policy case to emissions from a reference case. Costs were estimated by comparing policy and reference case new generating capacity investments, operating and maintenance costs for all generation, fuel costs for all generation, and transmission and distribution costs for all generation. The reported cost for the policy is the net present value of the difference in the above costs between the policy and reference cases. Because the NEMS model captures the CO2 tax in the price of fuel, we simply substituted the reference case price of fuel for the policy case price of fuel, which reflects the CO2 tax. In treating CO2 tax revenues in this way, we implicitly assumed that the revenues would be recycled back to Arizona. However, we did not distinguish how the revenue would be recycled, nor did we capture any macroeconomic effects of recycling. The costs reported are the direct social cost of the policy (not accounting for macroeconomic impacts), not the cost to utilities and ratepayers, which depends on whether and how revenues are recycled. Because the NEMS model is a national model with multi-state regions (Arizona is within the Rocky Mountain Power Area), the results for Arizona were derived from results in the region. We shared out the regional emission and cost results according to the share of Arizona generation within the region.

- **Key Assumptions:** Any analysis of state-level policies using the National Energy Modeling System (NEMS) from the US Energy Information Administration should be weighed carefully. NEMS is a national model that consists of 13 regions. State policies cannot be implemented explicitly within NEMS, and the state-specific impacts cannot be known explicitly. We must make assumptions about the impact of policies at the state level by sharing out regional results. In reality, the state-level changes resulting from policy may differ substantially from the changes in the region.

Key Uncertainties:

As with any assessment of the future, this analysis has many uncertainties. Key uncertainties are related directly to the key assumptions and quantification methods listed above. If those assumptions are incorrect, then the results would change. Other uncertainties include the forecast of the price of fossil fuels and the growth in the demand for electricity.

Ancillary Benefits and Costs, if applicable:

- The shift from fossil fuel generation that would result from a CO2 tax would lead to reductions in criteria air pollutants and, consequently, health impacts and costs associated with those pollutants.
- Shifting from an income tax to a CO2 tax could have economic benefits by encouraging productive activity and discouraging harmful emissions.

Feasibility Issues, if applicable:

Status of Group Approval:

Level of Group Support:

Barriers to consensus (if less than unanimous consent):

GRID AND UTILITY POLICIES

ES-9 Reduce Barriers to Renewables and Clean DG

Policy Description:

Remove barriers to renewables and clean DG including: commercialization barriers; price distortions; failure of the market to value the public benefits of renewables; failure of the market to value the social cost of fossil fuel technologies; and market barriers such as inadequate information, institutional barriers, high transaction costs because of small projects, high financing costs because of lender unfamiliarity and perceived risk, "split incentives" between building owners and tenants, and transmission costs are often higher for renewables.

Policy Design:

Policies to remove these barriers include: standard interconnection policies; procurement policies (e.g., state power purchases, loading order requirements, long-term contracting with clean DG, etc.); environmental disclosure, etc.

This policy is being quantified as RCI-6, Distributed Generation/Combined Heat and Power.

- **Goal levels:**

- **Timing:** Depends on specific policies to remove barriers.
- **Parties:** Depends on specific policies to remove barriers.
- Other:

Implementation method(s):

- Information and education
- Technical assistance
- Codes and standards
- Other

Related Policies/Programs in place:

Type(s) of GHG Benefit(s):

- CO2: By removing barriers to renewables and clean DG, more clean generation can come into the energy supply mix and displace fossil fuels, thereby reducing CO2 emissions.
- Black Carbon: To the extent that removing barriers to renewables and clean DG lead to displacement of generation from coal and oil, black carbon emissions will decrease.

Estimated GHG Savings and Costs Per Ton:

- ***This option quantified by RCI under RCI-6, Distributed Generation/Combined Heat and Power***

Data Sources, Methods and Assumptions (for quantified actions):

- **See RCI-6, Distributed Generation/Combined Heat and Power**

Key Uncertainties:

- **See RCI-6, Distributed Generation/Combined Heat and Power**

Ancillary Benefits and Costs, if applicable:

- Renewables and clean DG typically keep energy dollars in-state, contributing more to employment, fuel diversity and security, and price stability for the state.
- Water use may be reduced through renewable versus combustion technologies.

Feasibility Issues, if applicable:

Status of Group Approval:

Level of Group Support:

Barriers to consensus (if less than unanimous consent):

ES-10 Metering Strategies

Policy Description:

There are two common metering strategies and policies: net metering and advanced metering. Net metering is a policy that allows owners of grid-connected distributed generation (generating units on the customer side of the meter) to generate excess electricity and sell it back to the grid, effectively "turning the meter backward." This policy allows for low transaction costs (e.g., no need to negotiate contracts for the sale of electricity back to the utility) and is attractive to DG owners because they are compensated equal to their full cost of purchased electricity (i.e., the sum of wholesale generation, transmission and distribution, and utility administration costs) rather than just the utility's avoided costs.

Advanced metering is a technology that allows electricity consumers much greater opportunity to manage their electricity consumption. For example, consumers could set their meter to turn off or turn down air conditioning during the day while they are away. Coupled with pricing strategies that match prices to reflect actual costs during peak times, advanced metering could be set to automatically adjust demand by turning off lighting or appliances when the price reaches a threshold set by the consumer. A policy could be put into place to encourage the use of advanced metering by subsidizing the meters or by mandating their installation.

Policy Design:

Quantification of this policy option is still being considered. Inasmuch as it is more of an enabling policy (of clean, distributed generation) than a reduction policy per se, it may be more appropriate not to quantify it. It is also an enabling policy for RCI-6 and RCI-7, policy options which are being quantified.

- **Goal levels:**
- **Timing:**
- **Parties:** Utilities and utility customers.
- Other:

Implementation method(s):

- Information and education
- Technical assistance
- Funding mechanisms and or incentives
- Market-based mechanisms

Related Policies/Programs in place:

Type(s) of GHG Benefit(s):

- CO2: By encouraging more clean distributed generation through net metering, and lower demand through advanced metering, there will be less demand for CO2-intensive central generation, leading to reductions in CO2 emissions.
- Black Carbon: To the extent that net metering and reduced demand lead to less generation from coal and oil, black carbon emissions will decrease.

Estimated GHG Savings and Costs Per Ton:

- GHG potential in 2010, 2020
- Net Cost per tCO_2e in 2010, 2020

Data Sources, Methods and Assumptions (for quantified actions):

- Data Sources:
- Quantification Methods:
- Key Assumptions:

Key Uncertainties:

Ancillary Benefits and Costs, if applicable:

- To the extent that fossil fuel generation is reduced by metering strategies, reductions in criteria air pollutant emissions and, consequently, health impacts and costs associated with those pollutants, would also occur.
- Water use may be reduced through renewable versus combustion technologies.

Feasibility Issues, if applicable:

Status of Group Approval:

Level of Group Support:

Barriers to consensus (if less than unanimous consent):

ES-11 Pricing Strategies

Policy Description:

Pricing strategies can take many forms including: *real-time pricing* in which utility customer rates are not fixed, but reflect the varying costs that utilities themselves pay for power; *"time-of-use" rates*, which are fixed rates for different times of the day and/or for different seasons; *"increasing block" rates* that are defined by blocks of consumption; *green pricing* whereby customers are given the opportunity to purchase electricity with a renewable or cleaner mix than the standard supply mix offered by the utility; and *advanced metering* to allow electricity consumers much greater opportunity to manage their electricity consumption.

Policy Design:

Quantification of this policy option is still being considered. Inasmuch as some strategies may actually increase GHG emissions (though reducing costs), the significant uncertainties surrounding this policy option may make it appropriate not to quantify it. It is also closely related to RCI-8; the ES and RCI TWGs will continue to confer and select targets or ranges that may allow a comprehensive analysis to be done for all three policy options.

- **Goal levels:**
- **Timing:** Depends on the specific policies.
- **Parties:** Utilities and utility customers.

- **Other:**

Implementation method(s):

- Market-based mechanisms

Related Policies/Programs in place:

Type(s) of GHG Benefit(s):

- CO2: By encouraging less electricity consumption through pricing strategies, generation should be reduced, thereby reducing CO2 emissions.
- Black Carbon: To the extent that pricing strategies lead to less generation from coal and oil, black carbon emissions will decrease.

Estimated GHG Savings and Costs Per Ton:

- GHG potential in 2010, 2020
- Net Cost per tCO_2e in 2010, 2020

Data Sources, Methods and Assumptions (for quantified actions):

- Data Sources:
- Quantification Methods:
- Key Assumptions:

Key Uncertainties:

Ancillary Benefits and Costs, if applicable:

- To the extent that fossil fuel generation is reduced by metering strategies, reductions in criteria air pollutant emissions and, consequently, health impacts and costs associated with those pollutants, would also occur.
- Water use may be reduced through renewable versus combustion technologies.

Feasibility Issues, if applicable:

Status of Group Approval:

Level of Group Support:

Barriers to consensus (if less than unanimous consent):

ES-12 Integrated Resource Planning

Policy Description:

Integrated Resource Planning (IRP) is a process that diverges from traditional utility least-cost planning. Rather than simply focusing on supply-side options to meet a forecasted growth in emissions, IRP integrates technology and policy options on the demand side with supply side options to satisfy the anticipated demand for energy services. Demand-side measures include energy efficiency, distributed generation, and peak-shaving measures. IRP typically also takes into account a broader array of costs, including environmental and social costs.

Policy Design:

Quantifying CO2 reductions under a policy mandating IRP would require, in effect, conducting integrated resource planning for all utilities in the state, which is beyond the scope of this stakeholder process. Results of a cap and trade policy combined with extensive energy efficiency investments may approximate the results of such a policy. To quantify this option, the CCAG will use a "shadow price" for CO2, to be implemented in the fashion described below.

IRP is an involved process that, by its nature as a bottom-up planning methodology at the utility level, does not lend itself to setting implementation levels per se. The value given to emissions for use in the planning process can be specified, however. In the context of a climate-driven Arizona IRP, a "shadow price" per ton would be assigned to CO2 emissions. In making decisions about which resources to use to satisfy demand for energy services, utilities would be required to apply this "shadow price" as a CO2 adder in their evaluation of technologies and approaches. Utilities would not actually be required to pay this sum.

The TWG will conduct an analysis based on applying a shadow price of $15 per ton of CO2 emitted to approximate the results of an IRP process. The TWG may also consider assuming that a certain level of energy efficiency is implemented as a result of IRP.

- **Goal levels:** Implement IRP with a CO2 adder shadow price of $15 per ton of CO2 emitted.
- **Timing:**
- **Parties:** Utilities and the ACC.
- Other:

Implementation method(s):

- Water use may be reduced through renewable versus combustion technologies.
- Codes and standards
- Other?

Related Policies/Programs in place:

- No mandated IRP process is in use at this time in Arizona.

Type(s) of GHG Benefit(s):

- CO2: IRP is a planning process that attempts to factor in the external cost of emissions, including CO2. Lower emitting technologies are favored as a result. It also treats demand-side efficiency options as equal to supply-side options in the planning process, so fewer or smaller fossil fuel plants may be needed. The end result is potentially significant CO2 savings.
- Black Carbon: To the extent that generation from coal and oil is reduced under IRP, black carbon emissions will also be reduced.

Estimated GHG Savings and Costs Per Ton:

#	Policy	Scenario	Reductions (MMTCO2e)			NPV (2006–2020) $ millions	Cost-Effective-ness $/tCO2
			2010	2020	Cumulative Reductions (2006 - 2020)		
ES-12	Integrated Resource Planning	$15/ton CO2 adder	0.06	5.4	28	-70	-2

Data Sources, Methods and Assumptions (for quantified actions):

- **Data Sources:** Data for the electricity modeling done in this analysis comes from the US Energy Information Administration (EIA) and can be found within the National Energy Modeling System (NEMS). Data in NEMS includes representation of the existing generation, transmission and distribution system down to the unit level. NEMS also includes data that characterizes new plants that the model can choose to build to meet projected demand growth. EIA publishes Assumptions to the Annual Energy Outlook that details key assumptions in the current version of the model. EIA also publishes NEMS model documentation.
- **Quantification Methods:** As a proxy for the outcome of an IRP process, we applied a tax of $15 per ton CO2 to electricity generators at the national level. CO2 reductions were found by comparing emissions from the policy case to emissions from a reference case. Costs were estimated by comparing policy and reference case new generating capacity investments, operating and maintenance costs for all generation, fuel costs for all generation, and transmission and distribution costs for all generation. The reported cost for the policy is the net present value of the difference in the above costs between the policy and reference cases. Because the NEMS model captures the CO2 tax in the price of fuel, we simply substituted the reference case price of fuel for the policy case price of fuel, which reflects the CO2 tax. By making this assumption, we are treating the CO2 tax as a shadow price – tax revenues are ignored, but investment and operating decisions are made as if there were a CO2 tax in place. Because the NEMS model is a national model with multi-state regions (Arizona is within the Rocky Mountain Power Area), the results for Arizona were derived from results in the region. We pro-rated the regional emission and cost results according to the share of Arizona generation within the region.
- **Key Assumptions:** Any analysis of state-level policies using the National Energy Modeling System (NEMS) from the US Energy Information Administration should be weighed carefully. NEMS is a national model that consists of 13 regions. State policies cannot be implemented explicitly within NEMS, and the state-specific impacts cannot be known explicitly. We must make assumptions about the impact of policies at the state

level by sharing out regional results. In reality, the state-level changes resulting from policy may differ substantially from the changes in the region.

Key Uncertainties:

As with any assessment of the future, this analysis has many uncertainties. Key uncertainties are related directly to the key assumptions and quantification methods listed above. If those assumptions are incorrect, then the results would change. Other uncertainties include the forecast of the price of fossil fuels and the growth in the demand for electricity.

Ancillary Benefits and Costs, if applicable:

- IRP attempts to take into account social costs including the impact on the economy as well as health impacts and costs related to criteria air pollution.

Feasibility Issues, if applicable:

Status of Group Approval:

Level of Group Support:

Barriers to consensus (if less than unanimous consent):